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Laure Comont [(1)], Fatima Laggoun-Défarge [(1)] and Jean-Robert Disnar [(1)]
[(1)] ISTO, UMR 6113 CNRS/University of Orleans, BP 6759 45067 Orleans, France.

Peatlands have been exploited since the Middle Ages for diverse uses, including fuel, animal bedding and growth substrate in horticulture and agriculture. In many countries, these traditional peatland uses are now redundant, but the sites are being reappraised for their specific biodiversity and suitability for long-term carbon storage.

In order to moniter peat reaccumulation and hence long-term carbon sequestration in peatlands which have been abandoned or designated for restoration, it is essential to consider a wide range of indicators ([1]). Among these indicators, it has previously been shown that physico-chemical properties of peat organic matter (OM) provide clues for the understanding of bog restoration processes ([2]).

Accordingly, the aim of the present study was to comprehend the processes of spontaneous peat regeneration in a cutover peatland through elemental, micromorphological and biochemical composition of the peat OM.

Le Russey is a *Sphagnum*-dominated cutover peatbog in the French Jura Mountains where peat cutting was stopped in 1984 (surface area: 27 ha; elevation: 864 m; precipitation: 1349 mm). The area that had been exploited comprises a range of natural regeneration stages from bare peat (FRA) to advanced regeneration stage (FRC) with mixed vegetation (*Sphagnum spp*., *Polytrichum strictum*, *P.commune*, *Eriophorum vaginatum* and *E. angustifolium*). The uppermost 50 cm of the peat were cored in zones FRA and FRC, respectively, and compared to a reference profile (FRD) taken from an un-exploited zone of the peatbog.

All core sections were wet-sieved at 200 μm. Bulk samples and fine-grained fractions were subjected to elemental (C, N), and micromorphological analyses. The cellulosic and hemicellulosic sugars of the fine-grained fractions were identified and quantified by gas chromatography.

Results show contrasting chemical and micromorphological OM compositions. In the bare peat (FRA) section, C/N values remain consistently high (~40). The peat is mainly composed of amorphous OM and structureless tissues, with rather high proportions of microbial secretions, namely the mucilage in the lower levels. In the advanced regeneration stage (FRC), the C/N ratio decreases downcore with a clear threshold between the

regenerating litter and the “old” catotelm peat. The “young” peat is also characterised by the presence of well-preserved tissues of *Sphagnum, Polytrichum* and *Cyperaceae*. In contrast, the underlying “old” peat shows characteristic features of intensive OM degradation (low C/N ratios and high proportions of amorphous OM and mucilage). In the un-exploited area (FRD), C/N ratios decrease progressively with depth, indicating progressive diagenesis. The uppermost peat OM is mainly composed of well-preserved *Sphagnum* tissues being gradually replaced by mucilage downcore.

Sugar analyses were performed on some specific peatland plants (*Cyperaceae, Sphagna* and *Polytrichum*) as well as on peat samples to identify biological sources and to ascertain the degree of plant material degradation. These analyses were carried out on the fine-grained peat fraction (<200µm) supposedly typical of humifed material, i.e. with little or no unreworked plant remains and relatively high proportions of products of microbial syntheses. Globally, the results of the molecular approach support and complement those obtained by elemental analysis and micromorphological studies. In particular, in the advanced regeneration stage (FRC), the evolution with depth of total, cellulosic and hemicellulosic sugars confirm the subdivision of the profile into two distinct stages: the “young” peat section (0- 25 cm) presenting higher sugar content than the « old » peat (below 25 cm depth).

In summary, contrary to commonly perceived ideas, amorphisation does not correspond to “chemical” degradation. Even in the fine-grained fraction supposedly representing the most humifed material, high proportions of sugars (around 180-250 $mg.g^{-1}$ of sample) are still present. Even these compounds that are usually considered to be highly biodegradable, are well preserved both in intact and disturbed zones of the peatbog. The high sugar preservation allows use of such compounds both as indicators of humification and as tracers of plant sources.

References:

[1] Chapman S., Buttler A., Francez A.-J., Laggoun-Défarge F., Vasander H., Schloter M., Combe J., Grosvernier P., Harms H., Epron D., Gilbert D. & Mitchell E. (2003). Exploitation of northern peatlands and biodiversity maintenance: a conflict between economy and ecology. *Front. Ecol. Environ.*, 1(10): 525-532.

[2] Grosvernier P, Matthey Y and Buttler A 1995 Microclimat and physical properties of peat :new clues to the understanding of bog restoration processes. In Restoration of temperate wetlands, Eds B D Wheeler, S C Shaw, W S Fojt and R A Robertson.pp 437-450. John Wiley & Sons, Chichester, UK.